

TM 11-2039

WAR DEPARTMENT TECHNICAL MANUAL

PRELIMINARY INSTRUCTIONS

19C (SPL) OSCILLATOR PER D-166636
(MOISTURE-RESISTANT)

PRELIMINARY INSTRUCTIONS
19C (SPL) OSCILLATOR PER D-166636
(MOISTURE RESISTANT)



WAR DEPARTMENT • SEPTEMBER 1944

WAR DEPARTMENT

WASHINGTON 25, D. C., 26 September 1944

TM 11-2039, Audio Oscillator TS-379/U, 19C (SPL) Oscillator per D-166636 (moisture-resistant), is published for the information and guidance of all concerned.

[AG 300.7 (15 Jun 44)]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

J. A. ULIO

Major General

The Adjutant General

G. C. MARSHALL

Chief of Staff

DISTRIBUTION:

(For explanation of symbols see FM 21-6.)

CROSS INDEX OF WESTERN ELECTRIC COMPANY SPECIFICATIONS AND TECHNICAL MANUALS

<u>X-Specification</u>	<u>Technical Manual</u>	<u>Title</u>
X-61806	TM 11-2046	Instructions 67B and 67B(SPL) Test Sets per D-173231 Test Receiver with External Resistance
X-63641	TM 11-2021	Instructions Voice-Frequency Ringer Packaged Equipment
X-63653	TM 11-2029	Preliminary Instructions Voice-Frequency Carrier Telegraph Packaged Equipment
X-66038	TM 11-2034	Preliminary Instructions D-C Telegraph Repeater Packaged Equipment
X-66147	TM 11-2024	Preliminary Supplemental Instructions for the Installation of Voice-Frequency Carrier Telegraph Packaged Equipment
X-66150	TM 11-2031	Instructions for Line Terminating and Composite Panel and Type C Carrier Transfer Panel Packaged Equipment
X-66226	TM 11-2048	Instructions 32A(SPL) Transmission Measuring Set per X-66065A (Moisture-Resistant)
X-66227	TM 11-2040	Instructions 51A(SPL) Oscillator per X-66065B (Moisture-Resistant)
X-66228	TM 11-2026	Type C Carrier Telephone Packaged Equipment
X-66229	TM 11-2023	Preliminary Supplemental Instructions for the Installation of Type C Carrier Telephone Packaged Equipment (Moisture-Resistant)
X-66230	TM 11-2028	Preliminary Instructions Voice-Frequency Telephone Repeaters Packaged Equipment (Moisture-Resistant)
X-66231	TM 11-2027	Preliminary Supplemental Instructions for the Installation of Voice-Frequency Telephone Repeater Packaged Equipment (Moisture-Resistant)
X-66232	TM 11-2039	Preliminary Instructions 19C(SPL) Oscillator per D-166636 (Moisture-Resistant)
X-66233	TM 11-2045	Preliminary Instructions 13A(SPL) Transmission Measuring Set per D-165655 (Moisture-Resistant)
X-66234	TM 11-2044	Preliminary Instructions 5A(SPL) Attenuator per D-165654 (Moisture-Resistant)
X-66247	TM 11-2020	Preliminary Instructions Line Terminating and Simplex Panel Packaged Equipment
X-66251	TM 11-2033	Preliminary Instructions 2A(SPL) Test Unit
X-66259	TM 11-2030	Preliminary Instructions Test and Control Board Packaged Equipment
X-66260	TM 11-2042	Preliminary Instructions Volt-ohm-milliammeter per D-166852 Moisture-Resistant
X-66307	TM 11-2041	Description and Use of Tools, Gauges, and Materials for Installation and Maintenance of Packaged Equipment Offices
X-66464	TM 11-2047	Preliminary Instructions Hickok Model 560(SPL) Tube Tester per KS-9237 (Moisture-Resistant)

SAFETY NOTICE

ALWAYS REMOVE THE PLUG FROM THE RECEPTACLE AND THROW THE OFF-ON SWITCH LEVER TO THE OFF POSITION BEFORE REMOVING THE OSCILLATOR FROM THE BOX. WITH DOOR SWITCH D1 CLOSED AND THE POWER TURNED ON, THE CHASSIS AND ALL METAL PARTS CONNECTED TO IT, INCLUDING THE SHAFT OF P2 (METER ADJUSTMENT RESISTANCE), MAY BE AT LINE POTENTIAL. PROPER PRECAUTIONS SHOULD, THEREFORE, BE TAKEN TO AVOID ELECTRICAL SHOCK.

TABLE OF CONTENTS

<u>Paragraph</u>		<u>Page</u>
<u>SECTION I - DESCRIPTION</u>		
1	Use	1
2	Size and Weight	1
3	Power	1
4	Equipment Assembly	1
<u>SECTION II - EMPLOYMENT</u>		
5	General	3
6	Power Supply	3
7	Frequency Calibration	3
8	Frequency Settings	5
9	Output Settings	5
10	Transportation	6
<u>SECTION III - FUNCTIONING OF PARTS</u>		
11	General	7
12	Type of Construction	7
13	Frequency Control Dial	7
14	Circuit Diagrams	7
15	Circuit	8
16	Fixed Oscillator	8
17	Variable Oscillator	8
18	Low Frequencies	9
19	Modulator	9
20	Adjustment of Output Frequency	9
21	Power Supply	10
22	Heater and Plate Power	10
23	Extraneous Power Noise	10
24	Output Range	10
25	Output Meter	11

TABLE OF CONTENTS (CONT'D)

<u>Paragraph</u>		<u>Page</u>
<u>SECTION III - FUNCTIONING OF PARTS (CONT'D)</u>		
26	Output Current Variations	11
27	Output Frequency	11
28	Impedance	12
29	Harmonics	12
 <u>SECTION IV - MAINTENANCE</u>		
30	General	13
31	Vacuum Tubes	13
32	Meter Calibration	13
33	Defective Capacitors	14
34	Frequency Calibration	14
 <u>SECTION V - SUPPLEMENTARY DATA</u>		
35	Replaceable Parts	15

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	19C (SPL) Oscillator, Equipment Unit in Operating Position	VI
2	19C (SPL) Oscillator, Apparatus Side of Chassis and Inside of Case	2
3	19C (SPL) Oscillator, Terminal and Wiring Side of Chassis	4
4	Principal Circuit Features	8
5	Schematic and Circuit Label	27
6	Wiring Diagram	28

SECTION I

DESCRIPTION

1. USE.

a. The 19C (SPL) Oscillator is a heterodyne-type vacuum tube oscillator which provides a source of testing current for transmission measurements. It is capable of supplying an output from -4 dbm (4 db below a milliwatt into 600 ohms) to +6 dbm (6 db above a milliwatt into 600 ohms) over a frequency range from 30 cycles to 15 kilocycles. One control dial serves to vary the frequency continuously over the full range, but since for some uses a greater precision as to frequency is desired in the range below 250 cycles, an expanded scale is provided on the same dial and made effective by the operation of a switch. The oscillator employs five vacuum tubes and has an output impedance of about 600 ohms.

b. The 19C (SPL) Oscillator has component parts especially treated with moisture-resistant materials for use under tropical conditions, and differs in this respect from the 19C Oscillator. The circuit and operating features, however, are the same for both the 19C and 19C (SPL). The 19C (SPL) Oscillator is manufactured as the D-166636 Oscillator.

2. SIZE AND WEIGHT.

The 19C (SPL) Oscillator is provided in portable form equipped with a power supply cord and removable cover. It is approximately 15 inches long, 9-1/4 inches wide, and 9-1/2 inches high, weighing about 27 pounds.

3. POWER.

The power required for operation is a source of 105 to 125 volts which may be from either direct current or 50-60 cycles alternating current, consuming about 25 watts. The design is not suitable for use on 25-cycle power.

4. EQUIPMENT ASSEMBLY.

a. Figure 1 shows a face view of the 19C (SPL) Oscillator with the meter, binding posts, and adjustable features indicated.

b. Figure 2 shows a top view of the equipment with the chassis removed from the case. The case or housing for the chassis is also shown in this figure.

c. Figure 3 shows the wiring side of the equipment.

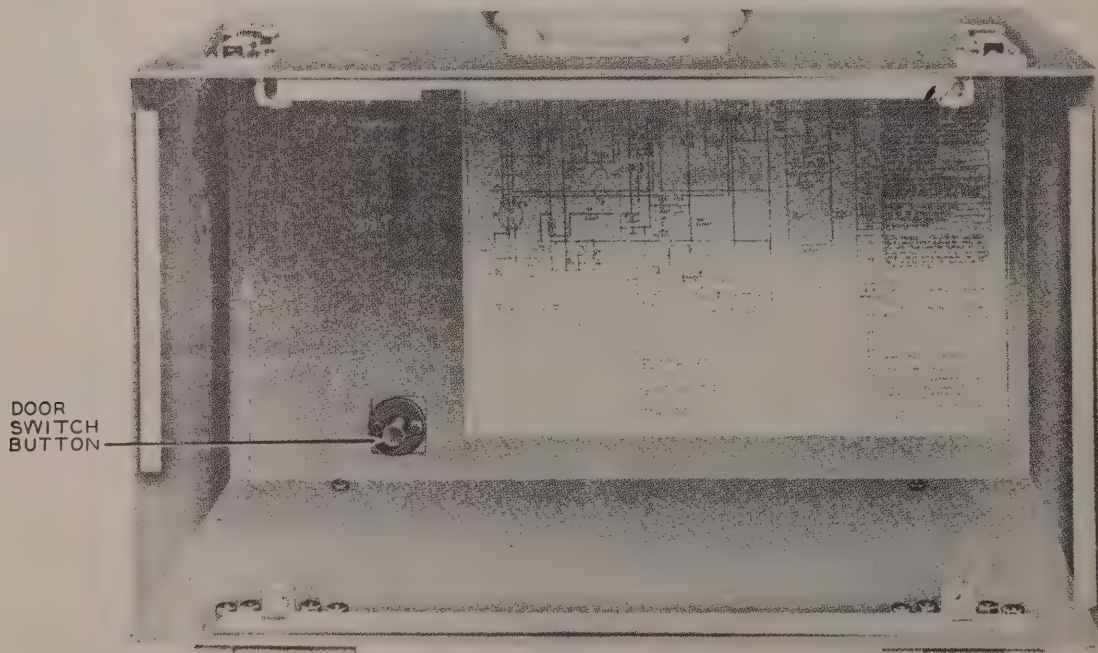
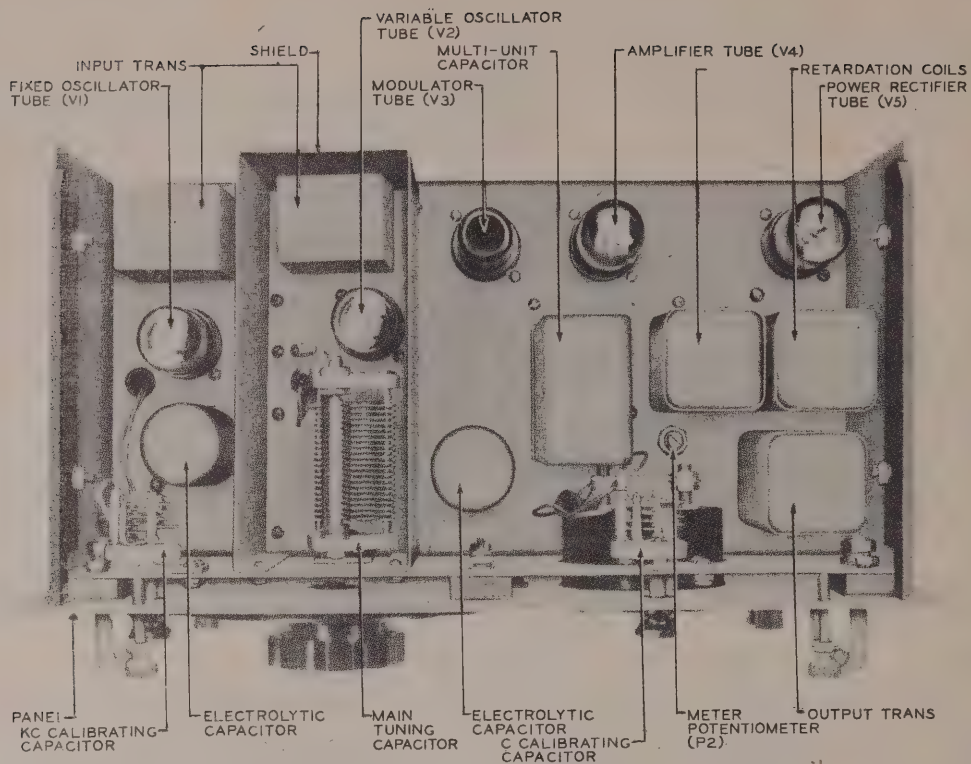


Figure 2 - 19C (SPL) Oscillator, Apparatus Side of Chassis and Inside of Case

SECTION IIEMPLOYMENT

5. GENERAL.

The best performance of the 19C (SPL) Oscillator will be obtained when operated under normal temperature conditions, calibrated in accordance with the procedure given in paragraph 7, and used on a uniform voltage supply of about 115 volts.

6. POWER SUPPLY.

Insert the plug of the power supply cord into the receptacle of the 105-125-volt supply which may be either direct current or 50-60 cycles alternating current and throw the OFF-ON toggle switch to the ON position. With a-c supply, either poling of the plug is normally satisfactory, but with d-c supply it is necessary to select the particular poling that results in output power. This is discernible on the meter shortly after connecting the power supply. It is desirable to allow a warming-up period of 10 minutes before proceeding with either calibrating the set or making measurements. If the oscillator is used without a warming-up period, its calibration should be checked occasionally until stable conditions are obtained.

7. FREQUENCY CALIBRATION.

a. Connect a 600-ohm circuit to the output terminals and turn the OUTPUT control knob to indicate approximately 0 db which is the calibrating point on the meter scale. This is the one milliwatt point on the scale.

b. Throw the C-KC toggle switch to the KC position and turn the frequency dial until the CAL lines are exactly opposite their respective indices. (Kilocycles CAL opposite KC and cycles CAL opposite C.)

c. Turn the small knob designated KC until the meter indication falls to the arrow without vibration. With reasonable care, this can be done to an accuracy of better than one cycle.

d. Throw the C-KC toggle switch to the C position and turn the small knob designated C until the meter indication falls to the arrow without vibration. This adjustment is dependent on the KC adjustment given above and must be rechecked whenever the KC adjustment is changed if the output frequencies in the CYCLES range are to be observed.

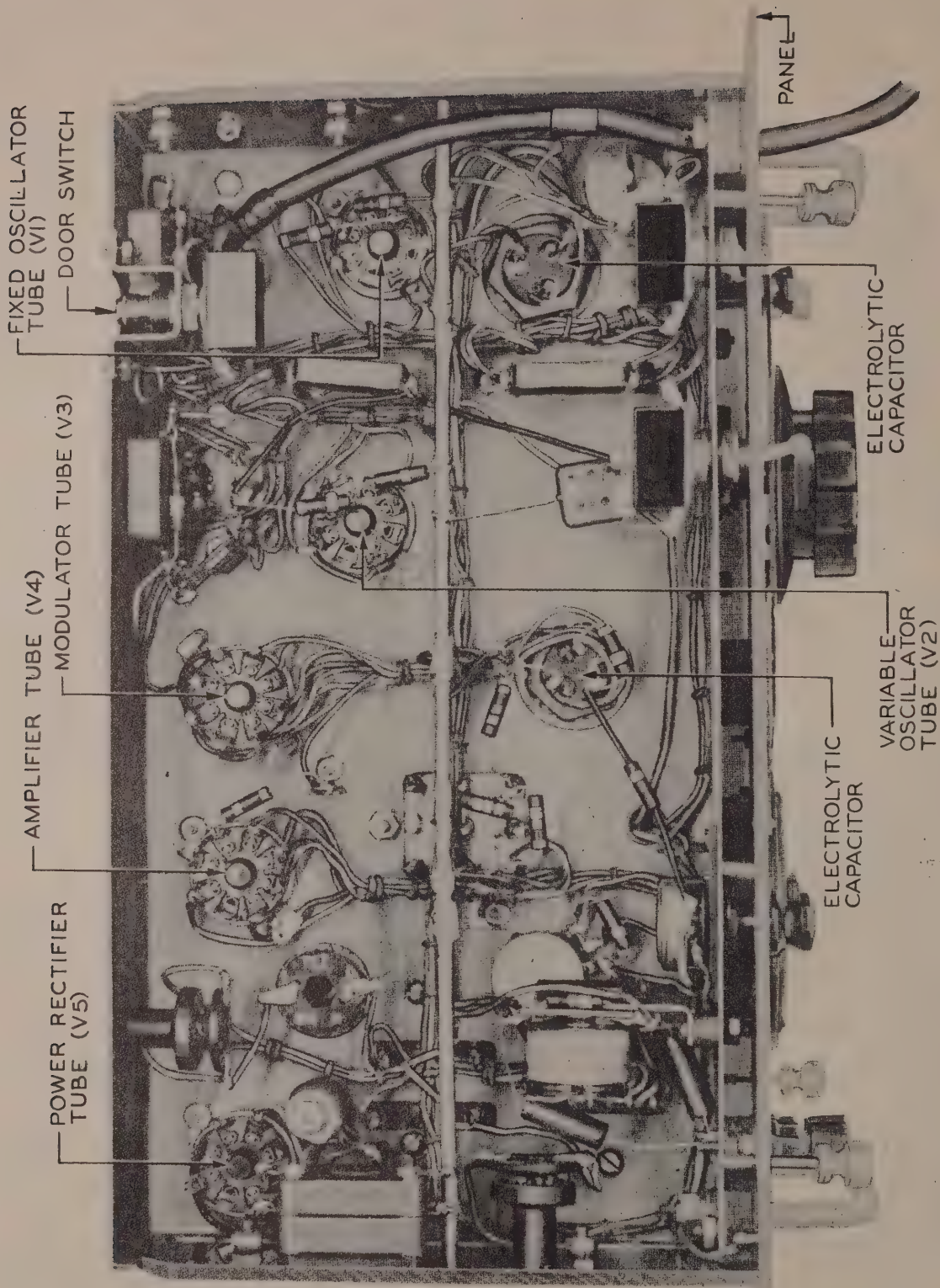


Figure 3 - 19C (SPL) Oscillator, Terminal and Wiring Side of Chassis

e. Since the C adjustment has a small effect on the KC adjustment, throw the C-KC toggle switch to the KC position and check that the meter indication falls to the arrow without vibration. If this is not the case, repeat the above paragraphs c through e.

8. FREQUENCY SETTINGS.

a. If the kilocycles scale is to be used, throw the C-KC toggle switch to KC and turn the frequency dial to the desired output frequency, such as 1 KC, using the KC index.

b. If the cycles scale is to be used, throw the C-KC toggle switch to C and turn the frequency dial to the desired output frequency, such as 100 cycles, using the C index.

9. OUTPUT SETTINGS.

a. With the calibration as described above, substantially the same output power will be supplied at any other frequency within either range indicated on the frequency dial.

b. The output is increased when the OUTPUT control knob is turned clockwise and may be operated at 0 dbm (one milliwatt) or at any value in the adjustable range from -4 dbm to +6 dbm. A ground lead should be connected under one of the knurled panel-mounting thumb screws when it is desired to improve the balance-to-ground of the output circuit.

c. If the impedance of the circuit to which the oscillator is connected is not 600 ohms, the power delivered by the oscillator to the circuit will not be exactly one milliwatt when the meter reads 0 db. In general, the power delivered to the circuit will be less than the meter reading due to the reflection loss. The value of the reflection loss will depend on the magnitude and angle of the circuit impedance. The following table gives the value of the reflection loss for circuits having impedances which are pure resistances. When the gain or loss of a circuit between its own impedance terminations must be known, the reflection loss should be added to the measured gain and subtracted from the measured loss.

REFLECTION LOSSES

<u>Impedance* of</u> <u>Circuit-ohms</u>	<u>Amount Output Power is</u> <u>Below Meter Reading -db</u>
200	0.6
300	0.1
600	0
1200	0.9
1800	1.9

*Assumed to be a pure resistance.

10. TRANSPORTATION.

In transporting the oscillator it is not necessary to remove the vacuum tubes from the sockets when reasonable precautions are taken to prevent vibration or jolts. When handling conditions are not controlled, the tubes should be removed and packed separately.

SECTION III

FUNCTIONING OF PARTS

11. GENERAL.

The output frequencies of the 19C (SPL) Oscillator are set by the frequency dial and are based upon a single point calibration, referred to as zero beat, which is indicated by the output meter. A calibration adjustment for frequency can be made for the prevailing temperature and voltage. The output power is indicated by a meter of the copper-oxide type in relation to one milliwatt into 600-ohm circuits. The output frequency and power of the 19C (SPL) Oscillator is normally taken to be the reading of the frequency scale and the reading of the output meter at the time of test. The accuracy of the readings, in terms of absolute frequency and output power, will be subject to wide deviation if operated under abnormal conditions such as sub-normal temperatures. Performance data given in the following paragraphs assumes that the temperature is between about 32F and 110F, that good vacuum tubes are used, that the oscillator has had a warming-up period of at least 10 minutes, and that the zero beat-frequency calibration has just been made.

12. TYPE OF CONSTRUCTION.

This apparatus is of a panel-chassis type construction and is contained in a steel housing. The effects of temperature variations on the output power and the output frequency have been minimized in so far as practicable in the selection and arrangement of the apparatus components of the oscillator.

13. FREQUENCY CONTROL DIAL.

The main frequency control dial includes a calibrated scale covering the full range of frequencies and also an expanded scale covering the low-frequency range. The position of the toggle switch C-KC indicates the scale and index to use in reading the output frequency. The two small knobs designated C and KC control air capacitor adjustments for zero output at the CAL setting on the frequency dial. A separate adjustment is made for C and KC positions of the C-KC toggle switch. The meter indicates the output and has been calibrated in db in relation to one milliwatt in 600 ohms. The output control serves to vary the oscillator output over a 10-db range from -4 to +6 dbm. The output is supplied from the OUTPUT binding post terminals.

14. CIRCUIT DIAGRAMS.

Detailed information on the circuit of the 19C (SPL) Oscillator is shown in figure 5. One copy is also fastened inside the oscillator box. Figure 6 shows a wiring diagram of the 19C (SPL) Oscillator.

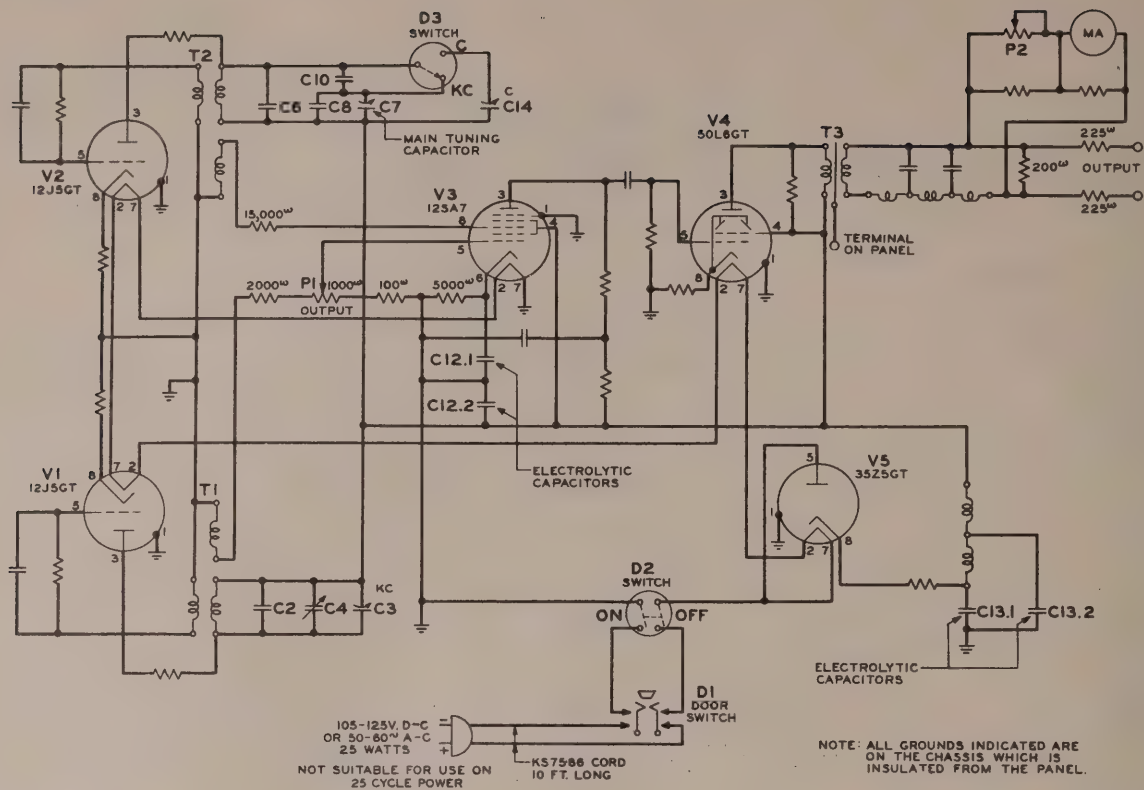


Figure 4 - Principal Circuit Features

15. CIRCUIT.

The principal circuit features of the 19C (SPL) Oscillator are shown in figure 4. The circuit consists of two single-tube oscillator circuits, one of which is adjustable in frequency and the other fixed. The two frequencies are supplied to a vacuum tube modulator circuit in which the difference frequency is produced. This is amplified and separated from the other modulation products to supply the desired output frequency.

16. FIXED OSCILLATOR.

The fixed oscillator circuit (vacuum tube V1) employs plate circuit tuning and generates a frequency of approximately 115 kilocycles. Most of the tuning capacitance is provided by an 800-micromicrofarad capacitor C2. It is supplemented by a 15-micromicrofarad variable capacitor C3, which is provided with a knob designated KC, accessible from the front of the panel for calibration purposes. C4 provides a factory adjustment for setting the fixed frequency to within the specified limits.

17. VARIABLE OSCILLATOR.

The circuit of the variable oscillator (vacuum tube V2) is similar to that of the fixed oscillator except that it includes a switch and capacitors

of different capacitance values. C6 provides a large part of the tuning capacitance. The main tuning capacitor C7 provides the output frequency adjustment. This requires a maximum capacitance of about 325 micromicrofarads. Capacitors C14 and C10 are switched into and out of the tuned circuit by the operation of the C-KC scale switch. C14 (15 micromicrofarads maximum) is arranged with a knob designated C, accessible from the front of the panel for calibration purposes. C10 (15 micromicrofarads) serves only in the CYCLES range of the dial and is connected in series with C7 to produce an expanded scale of the output frequencies for the range below 250 cycles. A 5-micromicrofarad fixed capacitor C8 is connected across C7.

18. LOW FREQUENCIES.

With the main tuning capacitor C7, the variable oscillator frequency can be decreased a maximum of about 15 kilocycles to supply any output frequency between about 30 cycles and 15 kilocycles. Capacitor C10, when connected in series, reduces the range of adjustment and results in the expanded low-frequency scale. C14 provides the zero beat-calibration adjustment for the CYCLES range of the dial and is operated by a knob designated C.

19. MODULATOR.

The high frequencies produced in the two oscillator circuits are supplied to the modulator (vacuum tube V3) which produce sum and difference frequencies as well as other modulation products. The modulator output is amplified by vacuum tube V4. The low-pass filter between the shielded output transformer T3 and the meter network suppresses modulation products other than the desired difference frequency output. The two 225-ohm resistors connected at the output terminals serve to build the impedance out to about 600 ohms and tend to reduce the effect of vacuum tube impedance on the output impedance of the oscillator. The amplifier includes negative feedback which results in a decrease in harmonic content and an improved frequency response. A rectifier-type meter provided in the output circuit serves to indicate the magnitude of the output power. Resistor P2 is provided to adjust the meter circuit so that the meter will read 0 db when the output is one milliwatt into 600 ohms. This adjustment is made at the factory and can be checked in the field as described in paragraph 32. Potentiometer P1 controls the output over a range of approximately 10 db by varying the fixed oscillator voltage supplied to the modulator.

20. ADJUSTMENT OF OUTPUT FREQUENCY.

The adjustment of the output frequency of the circuit is obtained by using the zero beat principle and employing the output meter as an indicator. When the tuning capacitor in the variable oscillator circuit is adjusted to the CAL division on the frequency scale, and the small capacitors in the oscillator circuits are adjusted in accordance with the switch positions

until the frequencies being generated in the two oscillators are the same, the resulting output frequency is zero and the output meter reading drops to the arrow. When the difference in frequency is less than about 20 cycles the output meter needle vibrates and readily indicates the difference frequency. This difference or beat frequency can be adjusted to zero, in which case output frequencies will be indicated correctly for other settings of the frequency dial. The control range of the frequency dial is determined by a factory adjustment of a variable capacitor C4 in the fixed oscillator circuit.

21. POWER SUPPLY.

Power is obtained from either a d-c or a 50-60-cycle a-c, 105-125-volt supply. With the type of power supply circuit suitable for either alternating current or direct current, the chassis may be at line potential above ground so the chassis has been insulated from the box. In addition to the OFF-ON switch, there is provided a door switch (see Safety Notice, page II) to automatically disconnect the power supply when the chassis is removed from the box.

22. HEATER AND PLATE POWER.

The vacuum tube heaters are connected in series across the power supply. Direct current for the plate and screen circuits of the vacuum tubes is provided by a vacuum tube rectifier with a coil and capacitor filter. The circuit will operate from d-c supply only when poled so that the chassis is connected to the negative supply lead. On a-c supply best performance will be obtained when poled so that the chassis is connected to the grounded supply lead.

23. EXTRANEIOUS POWER NOISE.

a. The shield of the output transformer T3 is connected to the panel instead of to the chassis in order to reduce the amount of extraneous power noise in the output. In the case of portable oscillators the oscillator can be grounded by connecting a ground lead under any one of the knurled panel mounting thumb screws.

b. Noise from 50-60-cycle supply is about -40 dbm (40 db below one milliwatt into 600 ohms) at the output of the oscillator. Noise from this and other external sources will not normally result in indications on the output meter. However, the effect of rapid surges of power supply voltage may be observed on the output meter even when noise is negligible.

24. OUTPUT RANGE.

The output of the 19C (SPL) Oscillator can be varied from -4 dbm to +6 dbm over a frequency range from 30 cycles to 15 kilocycles.

25. OUTPUT METER.

The output meter varies in accuracy and sensitivity, and its scale which is marked in db for indicating the output power is an averaged scale. The meter may therefore be the source of error when a deviation of the indicated output power from absolute power in db is suspected or observed. The meter accuracy for one-milliwatt output into 600 ohms, over the entire frequency range of 30 cycles to 15 kilocycles at temperatures between 32F and 110F is about ± 1 db if the meter has been adjusted for the conditions covered in paragraph 32. At 1000 cycles the accuracy is about ± 0.7 db. An adjustment of the meter circuit for rectifier aging can be made as covered in paragraph 32.

26. OUTPUT CURRENT VARIATIONS.

The maximum variations in the output meter of the 19C (SPL) Oscillator when the frequency is varied should be about ± 1 db over the 30 cycle to 15 kilocycle range and ± 0.5 db over the 50 cycle to 10 kilocycle range, when the output into 600 ohms is adjusted to read one milliwatt at 1000 cycles.

27. OUTPUT FREQUENCY.

a. From the standpoint of output frequency, the 19C (SPL) Oscillator is designed to supply any frequency over the full range by means of a single adjustment, but it is desirable for best accuracy in the range below 250 cycles to use the CYCLES range with the C-KC toggle switch thrown to the C position. Assuming that the oscillator has been calibrated and is operating normally at temperatures in the 32F to 110F range, the frequency should be the same as the scale indication within the following limits:

<u>FREQUENCY-CYCLES</u>	<u>DEVIATION FROM SCALE READINGS</u>
30-250	± 5 cycles
200	± 40 cycles or 20%
1000	± 50 cycles or 5%
2000	± 60 cycles or 3%
5000	± 100 cycles or 2%
15,000	± 150 cycles or 1%

b. Changes in frequency may occur due to changes in temperature, power voltage, or other causes, therefore, calibration adjustments should be made occasionally. After a warming-up period of about 10 minutes, the drift of the output frequency over periods of time such as two hours should be less than about 50 cycles at any frequency scale setting, provided the power line

Par. 27-29

voltage has not changed more than 5 volts. This 50-cycle maximum drift includes that due to temperature variation in the range from about 32F to 110F.

28. IMPEDANCE.

The output impedance is 600 ohms ± 10 per cent over the entire frequency range from 30 cycles to 15 kilocycles and 600 ohms ± 5 per cent at 1000 cycles.

29. HARMONICS.

The second or third harmonic content at one-milliwatt output is about -30 dbm for each.

SECTION IV

MAINTENANCE

30. GENERAL.

The periodic maintenance of the 19C (SPL) Oscillator may be confined principally to a check of the vacuum tubes. If the vacuum tubes are good, and yet unsatisfactory operation is noted, it usually will be necessary to remove the chassis (see Safety Notice, page II) and check the equipment items from the wiring diagram for a defective electrolytic condenser, a broken wire, etc.

31. VACUUM TUBES.

The vacuum tubes used in the 19C (SPL) Oscillators should be tested periodically and should be within the transconductance limits outlined in the vacuum tube Test Set I-177. The list of vacuum tubes together with the selector settings and transconductance values as listed in the Test Set I-177 are as follows:

<u>Tube No.</u>	<u>Average Mutual Conductance</u>	<u>Selectors</u>			<u>Pots</u>		<u>Test Conditions</u>
		<u>A</u>	<u>B</u>	<u>Fil</u>	<u>L</u>	<u>R</u>	
V1, 12J5GT	2000 micromhos	7	5	12.6	60	24	Amplifier
V2, 12J5GT	2000 micromhos	7	5	12.6	60	24	Amplifier
V3, 12SA7	750 micromhos	1	7	12.6	28	17	Amplifier No. 1 Grid
	750 micromhos	7	7	12.6	28	17	Amplifier No. 2 Grid
V4, 50L6GT	6000 micromhos	8	5	50.0	71	25	Amplifier
V5, 35Z5GT	-	11	1	35.0	40	0	Rectifier Standard

32. METER CALIBRATION.

The calibration of the output meter should be checked occasionally to verify that the 1000-cycle output of the oscillator is one milliwatt in 600 ohms when the meter indication is zero (one milliwatt). This should be done at times when a precise means of measuring one milliwatt is available and when the temperature is about 75F. When the deviation from one milliwatt is greater than about ± 0.4 db the output power should be readjusted to one milliwatt and the meter adjusting resistor P2 setting should be changed as necessary to indicate one milliwatt. This will necessitate removing the chassis from the box and closing switch D1. (See Safety Notice, page II.)

33. DEFECTIVE CAPACITORS.

The electrolytic capacitors should be replaced when found defective. This will usually be evidenced by a change in the stability of output, or by an increase in the power noise in the output. Unsatisfactory performance of the oscillator not due to vacuum tubes will probably be an indication of defective capacitors.

34. FREQUENCY CALIBRATION.

A check of the accuracy of the frequency dial can be made by a comparison test using a beat method with an oscillator which generates known frequencies in the range of this oscillator. If excessive deviations are noted troubles probably exist in the vacuum tubes, capacitors or elements in the oscillator circuits.

SECTION V
SUPPLEMENTARY DATA

35. REPLACEABLE PARTS.

a. General.—The reference designations shown in the first column of the table in paragraph 35c correspond to the designations shown on the detailed schematic and circuit label shown in figure 5. These designations are also stamped on the equipment or on the mounting adjacent thereto.

b. List of Manufacturers, 19C (SPL) Oscillator.

<u>Abbreviation</u>	<u>Name</u>	<u>Address</u>
A-B	Allen-Bradley Co.	Milwaukee, Wis.
Archo	American Radio Hardware Co.	New York, N. Y.
Clarostat	Clarostat Manufacturing Co.	Brooklyn, N. Y.
Commercial	Any Standard Manufacturer	-
Cunningham	R.C.A. Manufacturing Co.	Harrison, N. J.
Diamond	Diamond Expansion Bolt Co.	Garwood, N. J.
Eby	H. H. Eby, Inc.	Philadelphia, Pa.
G-R	General Radio Co.	Cambridge, Mass.
H & H	Arrow-Hart & Hegeman Elec. Co.	Hartford, Conn.
IRC	International Resistance Co.	Philadelphia, Pa.
Ken-Rad	Ken-Rad Manufacturing Co.	Owensboro, Ky.
K-K	Kurz-Kasch, Inc.	Dayton, Ohio
Raytheon	Raytheon Manufacturing Co.	Waltham, Mass.
RCA	R.C.A. Manufacturing Co.	Harrison, N. J.
Simplex	Simplex Wire & Cable Co.	Boston, Mass.
Sylvania	Hygrade Sylvania Corp.	Salem, Mass.
W. E. Co.	Western Electric Co.	New York, N. Y.

c List of Replaceable Parts - 19C (SPL) Oscillator

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
-		OSCILLATOR: Portable. Heterodyne vacuum tube oscillator. Operates on 105 to 125 volts d-c or on 105 to 125 volts 50-60 cps, a-c. Range -4 dbm to +6 dbm over a frequency range of 30 to 15,000 cps. The circuit consists of two vacuum tube oscillators one fixed at 115 kc and the other variable from 100 to 115 kc, operating into a vacuum tube modulator. The difference in frequencies from 30 to 15,000 cps is amplified and separated from other modulation products to supply the desired output frequency. Apparatus contained in 15-3/32" x 8-3/16" x 9-19/32" steel box with gray wrinkle finish. Moisture resistant for use under tropical conditions.	Provides a source of testing current for transmission measurements.	W. E. Co.	D-156636
OUTPUT	32727-9	BINDING POST: Insulating composition top, bakelite base, 3/4" high, 5/8" diameter of cap.	For connection to output supply.	Eby	No. 41 Commander P-4
-	3F3570-1/B1	BOX ASSEMBLY: Made from .0375" furniture steel having a gray wrinkle enamel finish and a hinged cover. Over-all dimensions approximately 9-19/32" x 8-13/16" x 15-3/32". Equipped with a chest handle and four rubber insulated feet. Cover can be locked with two flush head nickel-plated suitcase bolts.	For housing oscillator apparatus.	W. E. Co.	ES-654059
-	3F4270-2/B1	BRACKET: U-shaped steel .0625" with zinc and chromate finish. Base and each leg are 3/4" x 3/4" with right angle extensions 1/2" long on each leg. 1/2" diameter hole in center of base and 0.152 diameter holes on 1-3/8" centers in right angle extensions.	For supporting door switch D1.	W. E. Co.	ES-654061-5
-	423127	BUSHING: Black phenol fibre shoulder bushing 0.70" diameter.	To insulate switches D2 and D3 from chassis.	W. E. Co.	ES-624300-2
-	423124	BUSHING: Black phenol fibre shoulder bushing 7/8" diameter.	To insulate condenser C7 and potentiometer P1 from chassis.	W. E. Co.	ES-624469-2
-	3F3570-1/B2	BUSHING: Black phenol fibre shoulder bushing 3/8" diameter.	To insulate output transformer T3 from panel.	W. E. Co.	ES-624469-10
-	423125	BUTTON: Phenol fabric 1" diameter 1/8" thick disc with concentric projection 7/16" diameter x 9/16" thick.	Used to operate door switch D1.	W. E. Co.	ES-624438-5
-		CABLE CLAMP: Brass, 1/32" x 1 1/2" x 3/16", surface mounting clamp for 1/4" cable.	For strain relief on power supply cord. (Tyrex Type)	W. E. Co.	P-385516
-	222655-9	CABLE CLAMP: Steel, .062" x 1 1/2" x 1-1/8", consisting of half round clamping member 3/8" high suitable for 3/8" cable and a 1/2" x 9/16" flat mounting foot with 3/16" diameter hole in center.	For strain relief on power supply cord. (Braided Type)	Diamond	0-5

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
-	6D16821-1	CIRCUIT LABEL: Approximately 13" x 7-1/2" printed in black on white paper. Permanently affixed circuit diagram.	To aid in maintenance and understanding of circuit.	W. E. Co.	ES-654057
-	3F3570-1/C1	CHASSIS ASSEMBLY: Steel, .0437" thick, consisting of three separate parts attached together. Over-all dimensions 7" x 13-1/2" x 6-3/4". Two metal shields 2-3/4" apart are mounted between the frame and the chassis 2-13/16" from one end. Zinc plate and chromate finish.	For mounting the oscillator apparatus.	W. E. Co.	ES-654060
-	6D16821	CIRCUIT DIAGRAM: Circuit diagram.	For use in maintenance and understanding of circuit.	W. E. Co.	ESR-654058
-	4Z3433	CLAMP: Brass, solder dip finish, .04" stock, 3/8" wide, 1-5/16" long.	Provides connection between ground bar and chassis.	W. E. Co.	ES-625975-4
C1	3K5039211	CAPACITOR: Fixed, mica dielectric, .0039 μ f \pm 10%, 2500 w-v d-c -40F to +185F ambient temperature. Molded in insulating case 29/64" x 1-1/8" x 1-3/4". Holes for mounting 0.114" diameter on 1-5/16" centers. Lead alloy coated radial terminal on each end extending 33/64" from case with 0.180" hole. Moisture resistant. Same as C5.	Grid leak by-pass for vacuum tube V1.	Commercial	AMS Type CM504392K .0039 μ f
C2	3D9800-8	CAPACITOR: Fixed 800 μ f \pm 1/2%, 250 w-v d-c at -40F to 185F ambient temperature. Mica moulded in low loss material, 9/32" x 27/32" x 1-1/4", no. 18 AWG lead 1-1/2" long projects from each narrow end.	With C3 and C4 provides part of tuning capacitance for fixed oscillator.	W. E. Co.	D-162795 800 μ f
C3	3D9014V-3	CAPACITOR: Air-type, variable, when rotor and stator plates are completely interleaved the capacity is not less than 14 μ f and when the plates are completely disengaged the capacity is not more than 4.2 μ f. 250 w-v d-c at -40F to +185F ambient temperature. Stator assembly has five plates placed in alternate grooves of the stator post; rotor assembly has four plates placed in alternate grooves of shaft. Mounted on ceramic base 1/4" x 5/16" x 1-13/64", 0.112"-40 tapped mounting holes on 21/32" centers. Shaft, terminal and stator post extend at right angles to base for 1-5/32", 3/4" and 1-3/32" respectively. Brass operating shaft has screw driver slot. Same as C14.	With C2 and C4 provides (variable) part of tuning capacitance for fixed oscillator.	W. E. Co.	D-166988
C4	3D9075V-11	CAPACITOR: Air-type, variable, with rotor and stator plates completely interleaved the capacity is not less than 15 μ f and with the plates completely disengaged the capacity is not more than 6.0 μ f. 250 w-v d-c at -40F to +185F ambient temperature. Mounted on ceramic base, 1/4" x 15/16" x 1-13/64", 0.112"-40 tapped mounting holes on 21/32" centers. Ten rotor plates and eleven stator plates. Shaft, terminal and stator post extend at right angles to base for 13/16", 3/4" and 1-3/32" respectively. Brass operating shaft has screw driver slot.	Provides factory adjustment for setting fixed frequency within specified limits.	W. E. Co.	357G

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
C5	3K5039211	CAPACITOR: Same as C1.	Grid leak by-pass for vacuum tube V2	Commercial	AWS Type CM50A392K .0039 μ f
C6	3D9835	CAPACITOR: Same as C2, except 835 μ f.	Provides part of tuning capacitance for variable oscillator.	W. E. Co.	D-162795 835 μ f
C7	3D9330V	CAPACITOR: Variable, air, capacity at maximum setting 320 μ f to 330 μ f and at minimum setting not more than 13 μ f. 250 w-v d-c at -40F to +185F ambient temperature. 2-1/16" x 1-31/32" x 4-29/32", normal complement of 22 stator plates and 21 rotor plates. The stator plates are soldered to a common post and the rotor plates are soldered to a common shaft. Equipped with Steatite end plates and a 3/8"-32 threaded phosphor bronze mounting bushing 7/16" long and a 1/4" diameter plain brass shaft extending 1" beyond end of bushing.	Main tuning capacitance for variable oscillator.	W. E. Co.	D-166987
C8	-	CAPACITOR: 5 μ f $\pm 5\%$, 1 μ f, 500 w-v d-c at -40F to +184F ambient temperature. Silver mica laminations encased in low loss molded phenolic plastic. 9/32" x 9/16" x 3/4" long with no. 19 gauge wire axial leads 1-1/2" long. Moisture-resistant.	Padding capacitor in variable oscillator.	W. E. Co.	D-162794. 5 μ f
C9.1 C9.2, C9.3	3DA575	CAPACITOR: Paper dielectric, four separate units, capacity of each unit 0.575 μ f maximum, 0.425 μ f minimum, 250 w-v d-c at 0°F to 150F ambient temperature. Potted in gray lacquered can 1-15/32" x 2-13/32" x 4-23/32" high not including two 15/32" mounting studs and eight 31/32" long terminals projecting from top of can. Studs on 1-7/8" centers. Moisture resistant.	Interstage coupling capacitor. Plate supply by-pass to V3.	W. E. Co.	D-166874
C10	-	CAPACITOR: Same as C8 except 12 μ f to 18 μ f.	Padding capacitor in variable oscillator.	W. E. Co.	D-162794 12 to 18 μ f
C11	3K3010214	CAPACITOR: Fired, .001 μ f $\pm 20\%$, 500 w-v d-c at -40F to +185F ambient temperature. Mica dielectric, molded in insulating material, 9/32" x 53/64" x 53/64", axial wire lead 1-1/8" long at each end. Moisture resistant.	By-pass to ground for switch D3 housing.	Commercial	AWS Type CM30A102M .001 μ f
C12.1 C12.2	3DB50-11.1	CAPACITOR: Fired, dry electrolytic, two sections with common cathode concentrically wound and connected to a third lug. 16 μ f minimum in one section and 50 μ f minimum in other section. Maximum series effective resistance of 8 ohms and 2 ohms respectively at 120 cps. Maximum 200 w-v d-c at 50F to 130F ambient temperature. Round metal case, gray lacquer finish, 1-1/2" diameter x 4-3/4" high with a 7/8"-16 threaded bushing 7/16" long and three terminals 7/8" high projecting from top of the case. Over-all height 5-5/8". Moisture resistant.	Cathode resistance by-pass for vacuum tube V3.	W. E. Co.	KS-8679 16 μ f 50 μ f

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer Part No.
C13	3DB14-2	CAPACITOR: Fixed, dry electrolytic, two sections with a common cathode concentrically wound and connected to a third lug. 14.4 μ f minimum each section, 200 w-v d-c at 32F to 140F ambient temperature. Series effective resistance of 8 ohms at 120 cps. Metal case with gray lacquer finish, 1-3/8" diameter x 4-1/8" high including three lugs each 7/16" high.	Part of power supply filter circuit.	W. E. Co.	XS-8677
C14	3DS014V-3	CAPACITOR: Same as C3.	Used for calibration purposes in CYCLES range.	W. E. Co.	D-166988
C15	3K5024312	CAPACITOR: Fixed, mica dielectric, .024 μ f \pm 10%, 600 w-v d-c at -40F to +185F ambient temperature. Molded in insulating material .29/64" x 1-1/8" x 1-3/4". Holes for mounting 0.144" diameter on 1-5/16" centers. Lead alloy coated radial terminal on each end extending 33/64" from case with 0.18" hole. Moisture resistant.	Low-pass filter capacitor for limiting the carrier frequency to output terminals.	Commercial	AWS Type CM50A243K .024 μ f
C16	3K5015311	CAPACITOR: Fixed, .015 μ f \pm 10%, 600 w-v d-c at -40F to 185F ambient temperature. Same as C15.	Low-pass filter capacitor for limiting the carrier frequency to output terminals.	Commercial	AWS Type CM50A153K .015 μ f
-	3BK4035-12-1	*CORD: Two-conductor, no. 18 AWG rubber-covered cord 10'-0" long with molded nonpolarized plug cap. or *CORD: Two conductor, no. 18 AWG braided covering 10'-0" long with nonpolarized plug cap. or CORD: Two conductor, no. 18 AWG rubber-covered cord equipped with Habbell no. 7057 plug.	For supplying power to oscillator.	W. E. Co.	KS-7586
-	3F3570-1/G1	DIAL, ASSEMBLY: Round-6" diameter 1/32" steel, zinc plate with phosphate finish, upper half engraved 0.1, 0.5 and 1 to 15 kilocycles and lower part engraved for 50, 100, 150, 200, and 250 cycles in counter-clockwise direction. Figures are white in 1/8" characters.	To select frequency of output current.	W. E. Co.	ES-654064
-	424411	GUIDE: Black phenol fibre 3/16" x 1-3/8" x 6-3/4", two 0.1875 holes.	To guide chassis into box.	W. E. Co.	ES-624471-01
-	3F3570-1/G1	GUIDE: Phenol fibre 3/16" x 2-5/16" x 6-3/4" with 1-11/16" x 1" cutout at one end and a slotted opening near the center.	Insulates one end of chassis from carrying case and supports cable clamp (Diamond 0-5).	W. E. Co.	ES-654061-2
-	424411.1	GUIDE: Black phenol fibre, 3/16" x 1-3/8" x 6-3/4", two 0.1875 holes and two 0.161" holes.	To guide chassis into box.	W. E. Co.	ES-624471-7
-	625016-3	HANDLE: Steel, 5/16" diameter chromate plate finish, U-shape 4-5/16" long with 1-1/4" legs. Each leg has a 1/4" diameter x 1-1/16" long straight projection with a 0.250"-20 threaded end 5/8" long.	For lifting panel-chassis assembly out of the box.	W. E. Co.	ES-654061-6
C	3F3570-1/X1	INDEX: Brass, black nickel finish, 1/2" x 7/8" engraved C in white characters 3/16" high.	To indicate cycle readings on dial.	W. E. Co.	ES-625975-2

*A cable clamp, Stock No. 222635.8 or 222635.9, of the proper type should be furnished with each new cord.

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
KC	3F370-1/22	INDEX: Brass, black nickel finish, 1/2" x 7/8" engraved KC in white characters 3/16" high.	To indicate kilocycle readings on dial.	W. E. Co.	ES-625975-3
T1	229631-18	INPUT TRANSFORMER: Three windings, approximately d-c resistance (winding 1-2) 11.3 (winding 3-4) 23 (winding 5-6) 9. Air core coil on phenol fibre spool, potted in rectangular sheet metal case, 1-17/32" x 1-27/32" x 2-19/32" not including terminals or mounting studs. Same as T2.	Fixed oscillator transformer.	W. E. Co.	289A
T2	229631-18	INPUT TRANSFORMER: Same as T1.	Variable oscillator transformer.	W. E. Co.	289A
-	3G1838-84	INSULATOR: Black phenol fibre, 1/16" x 1" x 5-1/4", flat, two holes.	To insulate chassis from panel	W. E. Co.	ES-624470-10
-	3G1838-112	INSULATOR: Black phenol fibre, 1/16" x 1" x 7", flat, 0.2913" hole 1-1/2" from each end on lengthwise center line.	To insulate chassis from panel.	W. E. Co.	ES-624470-4
-	3G1838-112.1	INSULATOR: Black phenol fibre, 5/16" x 1" x 7", flat, five holes.	To insulate chassis from panel.	W. E. Co.	ES-624470-9
-	3G1838-112.2	INSULATOR: Black phenol fibre, 1/16" x 1" x 7", flat, two 0.2913" holes 1-1/2" from each end and one 0.625" hole 27/32" from one end. All holes on lengthwise center line.	To insulate chassis from panel.	W. E. Co.	ES-624470-11
-	3G1838-29	INSULATOR: Black phenol fibre, 3/32" x 3/4" x 1-13/16", flat, three holes (0.152"-0.139"-0.3906") on 3/16", 7/16", 17/32" horizontal and 3/8" vertical centers.	Spacer for potentiometer Pl.	W. E. Co.	
OUTPUT	225822-19	KNOB: Black molded plastic with octagonal top, 3/4" diameter x 17/32" high, hole 3/8" deep to fit 1/4" shaft, one set screw.	Output level control.	K-K	S-283-1
C	225822-19	KNOB: Same as OUTPUT.	Frequency calibration for CYCLES range.	K-K	S-283-1
KC	225822-19	KNOB: Same as OUTPUT.	Frequency calibration for KILOCYCLES range.	K-K	S-283-1
C and KC	225835-2	KNOB: Bakelite, 2-3/8" fluted knob with 3" skirt.	For rotating frequency dial.	G-R	637-R
M1	3F307-11	MILLIAMETER: Scale -4db to +6 db over 160 degrees calibrated for mounting on nonmagnetic material, 500 ±20% between terminals, 1 milliampere for full scale deflection at 60 cps -50F to +180F ambient temperature. Flush mounted 3-1/2" diameter x 1-7/16" deep, black bakelite case, two projecting threaded terminals 1/4" diameter x 3/4" long equipped with two nuts and two washers. Self contained rectifier.	Output level indicator.	W. E. Co.	D-167092

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
-	-	NAME PLATE: Phenolic, rectangular, 1/16" x 1-1/4" x 2-1/8", black finish with white border, .055" diameter hole at each corner. Engraved in white characters to read: Western Electric, made in U.S.A., D-16656 Oscillator, 105-125 Volts D.C. or 50-60 Cycles A.C., 25 Watts, Serial No. -	To show code name of apparatus and operating data.	W. E. Co.	ES-654065
T3	229632-55	OUTPUT TRANSFORMER: Impedance ratio 4500:600 ohms between windings (3-4) and (1-2). Operates over a frequency range of 200 to 3000 cps. The d-c resistance at 68F of winding (1-2) is 41 and winding (3-4) is 214. Direct capacitance between windings (1-2) and (3-4) with the case grounded is not greater than 55 p.f. Inductance of winding (3-4) 7.2 henries minimum. Shell type, permalloy core, metal case 1-11/16" x 1-11/16" x 3-9/16", gray lacquer finish, electrostatic shield between windings is connected to terminal 5. Five terminals 23/32" long on top of case.	Output transformer.	W. E. Co.	D-161897
-	3F3570-1/P1	PANEL ASSEMBLY: Steel, 1/8" x 8-1/2" x 14-3/4", aluminum enamel finish on front and edges. Engraved characters and markings filled in black.	For mounting dials, switches, binding posts, etc.	W. E. Co.	ES-654061-10
P1	227268-10	POTENTIOMETER: 1000" $\pm 20\%$, linear taper, 2 watts, OFF position at extreme counterclockwise position of shaft, composition, round metal case 1-1/16" diameter x 9/16", three projecting terminals 11/32" long, bushing 3/8" long, 0.250" diameter shaft extending 11/16" beyond bushing. Corrosion resistant.	Output control.	A-B	JCR 1000W
-	-	or POTENTIOMETER: 1000" $\pm 20\%$, linear taper, shaft 1-1/16" long from mounting surface with no flat, 3/8" long bushing.	Output control.	ClaroStat	Type 37W, 1000W, Part no. L-1686 IMS
P2	227269-21	POTENTIOMETER: 5000" $\pm 20\%$, linear taper, 2 watts, OFF position at extreme counterclockwise position of shaft, composition, round metal case 1-1/16" diameter x 9/16" long, three projecting terminals 11/32" long, bushing 3/8" long, 0.250" diameter shaft with screwdriver slot at end extending 1/4" beyond bushing. Corrosion resistant.	For adjusting calibration of output meter.	A-B	JCR 5000W
-	-	or POTENTIOMETER: 5000" $\pm 20\%$, linear taper, shaft 1/2" long from mounting surface with driver slot, 3/8" long bushing.	For adjusting calibration of output meter.	ClaroStat	Type 37W, 5000W, Part no. 106-C 5MS
R1	3Z4525 or 3RC21AF102K	RESISTOR: Metallized glass tube filament molded in phenol plastic compound, cylindrical, axial timed lead wires 1-1/2" long extending from each end, 1/2 watt, resistance $\pm 10\%$. Same as R2, R3, R5, R6, R7, R10, R13, R15, R16, R17, and R18.	Cathode bias for vacuum tube V1.	IRC or AWS	RT 1/2 1000W or RC21AF102K
R2	3Z6700-57 or 3RC21AF104K	RESISTOR: Same as R1.	Grid leak for vacuum tube V1.	IRC or AWS	RT 1/2 0.1 meg-ohm or RC21AF104K
R3	3Z4528 or 3RC21AF512J	RESISTOR: Same as R1.	Plate dropping for vacuum tube V1.	IRC or AWS	RT 1/2 5000W or RC21AF512J

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
R5	3Z4525 or 3RC2LAF102K	RESISTOR: Same as R1.	Cathode bias resistor for vacuum tube V2.	IRC or AWS	BT 1/2 1000 ^W or RC2LAF102K
R6	3Z6700-57 or 3RC2LAF104K	RESISTOR: Same as R1.	Grid leak resistor for vacuum tube V2.	IRC or AWS	BT 1/2 0.1 megohm or RC2LAF104K
R7	3Z4528 or 3RC2LAF512J	RESISTOR: Same as R1.	Plate dropping resistor for vacuum tube V2.	IRC or AWS	BT 1/2 5000 ^W or RC2LAF512J
R10	3Z6725-17 or 3RC2LAF244J	RESISTOR: Same as R1.	Grid leak resistor for vacuum tube V4.	IRC or AWS	BT 1/2 .25 megohm or RC2LAF244J
R13	3Z4528 or 3RC2LAF512J	RESISTOR: Same as R1.	Cathode bias resistor for vacuum tube V3.	IRC or AWS	BT 1/2 5000 ^W or RC2LAF512J
R15	3Z6660-2 or 3RC2LAF623J	RESISTOR: Same as R1.	Plate supply resistor for vacuum tube V3.	IRC or AWS	BT 1/2 60,000 ^W or RC2LAF623J
R16	3Z6650-45 or 3RC2LAF513J	RESISTOR: Same as R1.	Part of plate supply resistance-capacitance filter for vacuum tube V3.	IRC or AWS	BT 1/2 50,000 ^W or RC2LAF513J
R17	3Z6040-20 or 3RC2LAF391J	RESISTOR: Same as R1.	Cathode bias resistor for vacuum tube V4.	IRC or AWS	BT 1/2 400 ^W or RC2LAF391J
R18	3Z6200-57 or 3RC2LAF202J	RESISTOR: Same as R1.	Meter circuit for adjusting resistor.	IRC or AWS	BT 1/2 2000 ^W or RC2LAF202J
R9	3Z6010-16	RESISTOR: Fixed, 100 ^W ±10%, 1/2 watt. Wire wound on textile core, molded in phenolic compound, cylindrical, 3/16" diameter x 5/8" long, 1-1/2" axial wire lead at each end. Moisture-resistant.	With R4 forms fixed oscillator output control resistors.	IRC	BW 1/2 100 ^W
R11	3Z6020-51	RESISTOR: Fixed, 200 ^W ±5%, maximum 10 watts, wire wound single layer on porcelain tube, 23/32" diameter x 1" long, 2-9/16" projecting terminals near each end perpendicular to axis, vitreous enameled, mounted by 0.344" diameter rod through center of unit.	Current limiter for filament of vacuum tube V5.	W. E. Co.	D-165647 200 ^W
R19		RESISTOR: Fixed, 300 ^W ±10%, 1/2 watt, wire wound, lacquer impregnated cellulose acetate sheets, muslin covered, cylindrical, 0.39" diameter x 1-7/16" long, stranded wire axial leads 1-1/2" long moisture-resistant. (Note: A 500 ^W resistor is wired in initially. After the oscillator is tested, it may be necessary to substitute a 300 ^W , 400 ^W , 600 ^W or 700 ^W resistor.)	Meter shunt resistor for factory calibration.	W. E. Co.	D-169360, 300 ^W , 400 ^W , 500 ^W , 600 ^W , or 700 ^W
R20	3Z6022E5-4.1	RESISTOR: Fixed, 225 ^W ±1%, 1/4 watt, low reactance, cylindrical 5/16" diameter x 1" with axial wire leads 2" long. Wire wound on bakelite core with phenol fibre outer tube. Same as R21.	To fix the output impedance of the oscillator.	W. E. Co.	D-164986A 225 ^W
R21	3Z6022E5-4.1	RESISTOR: Same as R20.	To fix the output impedance of the oscillator.	W. E. Co.	D-164986A 225 ^W

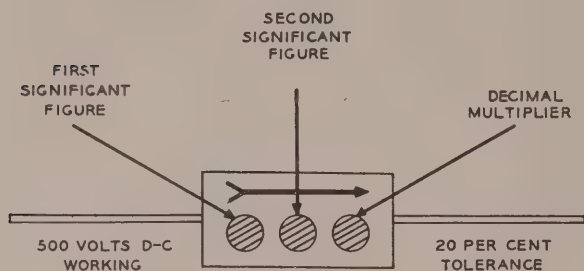
Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
R4 and R8	3F3570-1/M1	RESISTOR MOUNTING ASSEMBLY: One 2000 ω and one 15,000 ω IRC, BT 1/2 resistor each connected to two Zierick no. 150 terminals. Resistors are mounted on phenol fibre 1/16" x 3/4" x 1-1/8" which is supported by L-shaped bracket 1/16" x 5/16" x 7/16" x 1-5/16" riveted to center of panel. Short leg of bracket has 0.152" diameter hole. Same as RC.	Fixed output control resistor. Variable output control resistor.	W. E. Co.	ES-654061-9
R12 and R14	3F3570-1/M3	RESISTOR MOUNTING ASSEMBLY: One W. E. Co. (D-164886A) 200 ω and one IRC BT 1/2 20,000 ω resistor each connected to two Zierick no. 150 terminals, 7/8" apart 7/32" from each end. Mounted on 1/16" phenol fibre, rectangular, 1-1/4" x 1-5/16", supported by 1/16" x 5/16" x 7/16" x 1-7/8" L-shaped bracket riveted to center of panel. Panel has a 0.1875" diameter hole centrally located in line with a 0.164"-32 tapped hole in bracket. Same as RL4.	Terminating resistor for transformer T3. Terminating resistor for output filter.	W. E. Co.	ES-655878-1A
L1	3C1987-83	RETARDATION COIL: D-c resistance of winding (1-6) at 68F is 200 ω and minimum inductance at 200 cps with 45 milliamperes superimposed d-c is 5 henries. Insulation resistance between winding and case and winding and core is capable of withstanding 500 volts a-c. Shell type, silicon steel core, metal case 1-11/16" x 1-11/16" x 3-9/16", gray lacquer finish, equipped with two 23/32" terminals on top of case. Same as L2.	Power supply filter inductance.	W. E. Co.	D-163883
L2	3C1987-83	RETARDATION COIL: Same as L1.	Power supply filter inductance.	W. E. Co.	D-163883
L3	3C1988-3	RETARDATION COIL: Inductance 0.52 millihenry and d-c resistance approximately 5 ω . Molded black phenol plastic spool on which is a duolateral wound coil, supported by bolt through center. 1-7/16" diameter x 1-5/32" high. Same as L5.	Low pass filter inductance for limiting the carrier frequency to the output terminals.	W. E. Co.	200BJ
L4	3C1988-1.1	RETARDATION COIL: Inductance 0.99 to 1.03 millihenry, maximum d-c resistance 8 ω . Molded black phenol plastic spool on which is a duolateral wound coil with a cellulose acetate cover, supported by bolt through center. 1-7/16" diameter x 1-5/32" high.	Low pass filter inductance for limiting the carrier frequency to the output terminals.	W. E. Co.	200H
L5	3C1988-3	RETARDATION COIL: Same as L3.	Low pass filter inductance for limiting the carrier frequency to the output terminals.	W. E. Co.	200BJ
-	6Z3203	ROD: Copper, 13-5/8" x 0.18" solder dip finish.	Common grounding strip.	W. E. Co.	ES-625975-5

Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
-	427132	SPACER: Black phenol fibre, 5/16" x 1" x 5-1/4", four holes.	To insulate chassis from panel.	W. E. Co.	ES-624470-7
-	427144	SPACER: Black phenol fibre, 5/16" x 1" x 7", four holes.	To insulate chassis from panel.	W. E. Co.	ES-624470-8
D1	329824-31.1	SWITCH: Normally open, double-pole, single throw, 3 amperes, 250 volts, Switch mechanism enclosed in 5/8" x 9/16" x 1-1/8" molded bakelite housing with two 1/4" terminals at each end, mounting bushing and push button mechanism extend 1-1/16" above insulating material, bushing 15/32"-32 thread. Single hole mounting in panel.	To automatically disconnect the power supply when the chassis is removed from the box.	EEH	81069BD
D2		SWITCH: Toggle, double pole, single throw, 3 amperes, 250 volts, mechanism enclosed in 5/8" x 9/16" x 1-1/8" molded bakelite housing with two 1/4" terminals at each end, mounting bushing and switch mechanism extend 5/8" above insulating material, bushing 15/32"-32 thread, single hole mounting in panel.	For turning oscillator ON and OFF.	EEH	81024AL
D3	329858-3.1	SWITCH: Double pole, double throw, 3 amperes, 250 volts, mechanism enclosed in 5/8" x 9/16" x 1-1/8" molded bakelite, two 1/4" terminals at each end and two 9/32" terminals at bottom, mounting bushing and switch mechanism extend 7/8" above insulating material, bushing 15/32"-32 thread, single hole mounting in panel.	Frequency range selection switch.	EEH	81012AE
-	3212075-10	TERMINAL: L-shape, solder dip finish .038" x 7/16" long x 3/8" high. Short leg is circular with 0.172" inside diameter and 5/16" outside diameter. Long leg is 11/64" wide, has .072" diameter hole for wire connection 5/64" from top.	For internal connection to output binding posts.	W. E. Co.	P-127355
-	3212075-9	TERMINAL: Sheet brass with nickel dip finish, .0452" x 9/16" x 1" long with rounded ends, one end bent 30 degrees from base has 0.115" diameter wire hole, other end has 0.257" diameter screw hole 5/16" from bend.	For connections to meter M1.	W. E. Co.	P-225678
-	3212027-1	TERMINAL: Round flat copper, solder dip finish .020" x 0.5" inside diameter x 3/4" outside diameter. Half round soldering terminal 3/8" long projects at 45 degree angle.	To ground frame of switch D3.	W. E. Co.	ES-686251-3
-	229402.16	TERMINAL LUG STRIP: Brown bakelite strip 1/16" x 3/8" with two brass soldering lugs attached. Over-all length 1-1/8".	Termination for resistors R17 and R20.	Archo	512

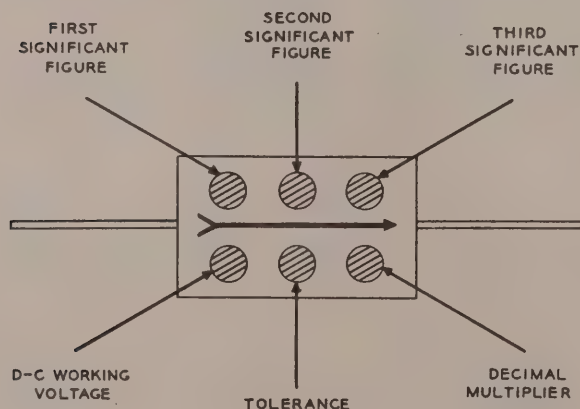
Reference Designation	Stock No.	Name and Description	Function	Manufacturer	Manufacturer's Part No.
V1	2V12J5GT	VACUUM TUBE: Heater 12.6 volts a-c or d-c. 0.15 ampere plate voltage 300 volts maximum, grid 0 volts minimum, plate dissipation 2.5 watts maximum, coated unipotential cathode. Detector amplifier triode. Glass bulb and intermediate shell octal 6-pin base. Over-all length 3-5/16" maximum, seated height 2-3/4", diameter 1-5/16". Pin no. 1 no connection, pin no. 2 heater, pin no. 3 plate, pin no. 5 grid, pin no. 7 heater, pin no. 8 cathode. Same as V2.	Fixed oscillator vacuum tube.		12J5GT
V2	2V12J5GT	VACUUM TUBE: Same as V1.	Variable oscillator vacuum tube.		12J5GT
V3	2V12SA7	VACUUM TUBE: Filament voltage 12.6, current 0.15 ampere, plate voltage 300 volts maximum, voltage grid 2 & 4 100 volts maximum, supply voltage grids 2 & 4 300 volts maximum, total cathode current .014 ampere maximum, conversion transconductance 450 micromhos, 2-5/8" long, 2-1/16" seated height, 1-5/16" diameter pentagrid converter, coated unipotential cathode, metal shell, 8-pin octal socket.	Modulator or mixer vacuum tube.	RCA, Sylvania, Cunningham, Raytheon, or Ken-Rad	12SA7
V4	2V50L6GT	VACUUM TUBE: Beam power amplifier, heater 50 volts, a-c or d-c, 0.15 ampere, plate voltage 200 volts maximum, screen voltage 117 volts maximum, plate dissipation 10 watts maximum, transconductance 9500 micromhos, 3-5/16" high, 2-3/4" seated height, 1-5/16" diameter, coated unipotential cathode, glass bulb and octal 7-pin base.	Amplifier vacuum tube.		50L6GT
V5	2V3Z5GT	VACUUM TUBE: Heater 35 volts a-c or d-c 0.15 ampere, maximum a-c plate voltage 235 rms, maximum peak inverse voltage 700 volts, maximum peak plate current 600 milliamperes, maximum d-c output current 100 milliamperes, 3-5/16" high, 2-3/4" seated height, 1-5/16" diameter, glass bulb, half wave, high vacuum rectifier, coated unipotential cathode, center tapped heater, octal 6-pin base.	Power supply rectifier vacuum tube.		3Z5GT
VSL	228678.25	VACUUM TUBE SOCKET: Used for octal style metal vacuum tube, 1-25/32" x 1-9/32" x 5/8" over-all, two 0.1406 mounting holes, 1-1/2" apart, eight phosphor-bronze silver plated contacts, 2 ground lugs, mounting shell made of .02" half-hard cold rolled steel with zinc plate finish, bakelite insulating washer, pressure of 12 to 18 pounds required to insert tube. Same as VS2, VS3, VS4, VS5.	Socket for fixed oscillator tube.	W. E. Co.	Type 39-PG-1E KS-10067
VS2	228678.25	VACUUM TUBE SOCKET: Same as VSL.	Socket for variable oscillator tube.	W. E. Co.	Type 39-PG-1E KS-10067
VS3	228678.25	VACUUM TUBE SOCKET: Same as VSL.	Socket for modulator or mixer tube.	W. E. Co.	Type 39-PG-1E KS-10067
VS4	228678.25	VACUUM TUBE SOCKET: Same as VSL.	Socket for amplifier tube.	W. E. Co.	Type 39-PG-1E KS-10067
VS5	228678.25	VACUUM TUBE SOCKET: Same as VSL.	Socket for power supply tube.	W. E. Co.	Type 39-PG-1E KS-10067

d. Color Code Chart.

RMA Color Codes for Capacitors (mmf)



Color	Numeral	Volts	Multiplier	Tolerance
Black	0		1	
Brown	1	100	10	1%
Red	2	200	100	2%
Orange	3	300	1,000	3%
Yellow	4	400	10,000	4%
Green	5	500	100,000	5%
Blue	6	600	1,000,000	6%
Violet	7	700	10,000,000	7%
Gray	8	800	100,000,000	8%
White	9	900	1,000,000,000	9%
Gold		1000	0.1	5%
Silver		2000	0.01	10%
No color		500		20%

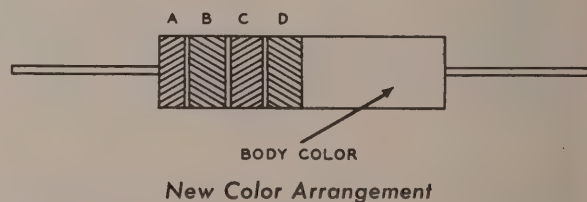
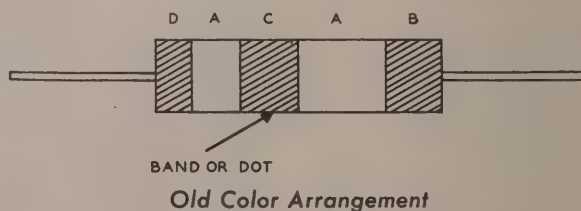


RMA Color Codes for Resistors (ohms)

Color	A 1st Digit	B 2nd Digit	C Multiplier
Silver			0.01
Gold			0.1
Black		0	1.0
Brown	1	1	10
Red	2	2	100
Orange	3	3	1,000
Yellow	4	4	10,000
Green	5	5	100,000
Blue	6	6	1,000,000
Purple	7	7	10,000,000
Gray	8	8	100,000,000
White	9	9	

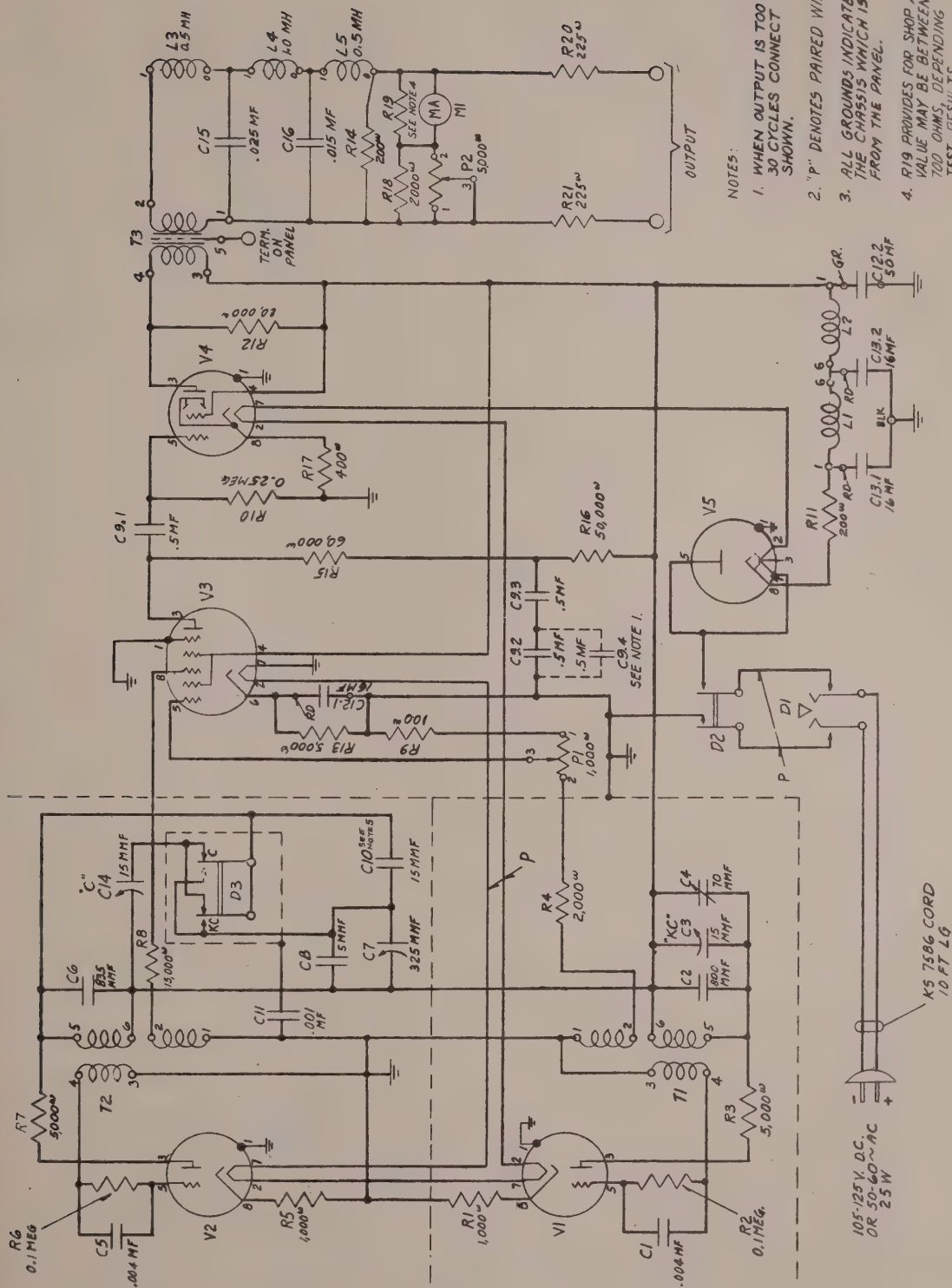
D-Tolerance Code:

Gold=5% Silver=10% No color=20%



Body color (new color arrangement only) indicates type of resistor, as follows:

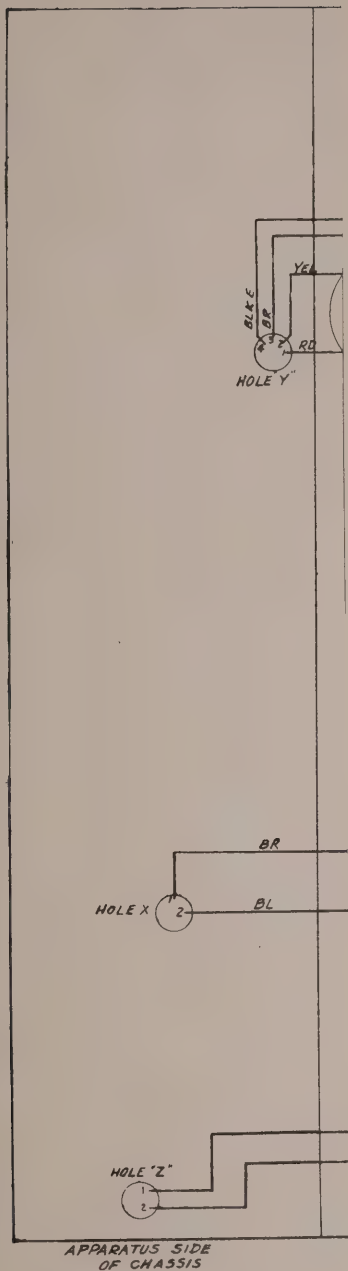
- Black—composition, non-insulated
- Tan, olive or white—composition, insulated
- Dark brown—wire-wound, insulated



NOTES:

1. WHEN OUTPUT IS TOO HIGH AT 30 CYCLES CONNECT C9,4 AS SHOWN.
2. "P" DENOTES PAIRED WIRES
3. ALL GROUNDS INDICATED ARE ON THE CHASSIS WHICH IS INSULATED FROM THE PANEL.
4. R19 PROVIDES FOR SHOP ADJUSTMENT. VALUE MAY BE BETWEEN 300 & 700 OHMS, DEPENDING UPON TEST RESULTS.
5. C10 PROVIDES FOR SHOP ADJUSTMENT. VALUE MAY BE BETWEEN 12 AND 18 MF DEPENDING ON TEST RESULTS.

Figure 5 - Schematic and Circuit Label



NOTES:

1. APPARATUS DESIGNATIONS ARE FOR REFERENCE.
2. WIRES MARKED "A" ARE "AM" WIRE 20 GA. PER 161.164 & 165 AND ARE OPEN FORMED WIRING. WIRES ARE PER ITEMS 158 TO 166 & 174 AND IN A FORMED CABLE AS PER ESO 697033.
3. WIRES MARKED "B" ARE "B" GA. "T" WIRE.
4. WIRES MARKED "C" ARE LEADS OF APPA.
5. WIRE MARKED "E" IS TYPE AM WIRE ITEM 156 FORMED CLEAR OF CHASSIS SHOWN ON PHOTOGRAPHS "83168 AND
6. RESISTORS AND CONDENSERS WITH V SHALL BE MOUNTED BY THEIR RESPEC IN APPROXIMATE POSITION SHOWN ON ESX-654036 LEAD SHALL BE PASS. TERMINAL HOLE WHERE PROVIDED AN ONCE AROUND TERMINAL AND SOLDER

